

BIOLOGY AND IMMATURE STAGES OF
CYLINDROCOPTURUS QUERCUS (SAY)
(COLEOPTERA: CURCULIONIDAE)

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ABSTRACT

The life history and habits of *Cylindrocopturus quercus* (Say), a curculionid associate of common ragweed, *Ambrosia artemisiifolia* L., are discussed. Adults began appearing in early June with peak populations emerging in late June. Eggs were deposited in the basal half of a stem near nodes. Larvae tunneled and fed upon cortical, vascular, and pith parenchyma tissues. The mature larvae overwintered in a state of temperature-induced quiescence. Pupation occurred during the spring in specially prepared chambers located at the ends of larval burrows. The weevil is univoltine in northeastern Ohio. Diagnostic descriptions and illustrations of the immature stages are presented for the first time.

INTRODUCTION

Common ragweed, *Ambrosia artemisiifolia* L. (Compositae), is a well-known medically important, aeroallergenic pollen-producing plant responsible for late summer hayfever throughout much of North America. In northeastern Ohio, the weed supports a diverse assemblage of phytophagous Coleoptera, many of them poorly known biologically. One such insect is the curculionid *Cylindrocopturus quercus* (Say). Since the insect fauna attacking the ragweeds is of current interest in biological control (Harris and Piper 1970, Kovalev and Runeva 1970, Gilstrap and Goeden 1974, Goeden *et al.* 1974, Goeden and Ricker 1974a, b, 1975, 1976) and because no biological information was available on the life history and habits of *C. quercus*, the present study was initiated.

The genus *Cylindrocopturus* Heller (Curculionidae: Zygopinae) contains 42 Nearctic and Neotropical species, 28 of which are restricted to the United States (C. W. O'Brien, pers. comm.). The adult taxonomy of the genus is relatively well understood. In contrast, comparatively few detailed larval and pupal descriptions have been published (Keifer 1930, Anderson 1941). Larval feeding habits within the genus are quite varied (Pierce 1916, Buchanan 1940), but most species for which hosts are known are associated with members of the Compositae (Böving 1926). Species collected from ragweeds include *C. adpersus* (LeConte) from *A. acanthicarpa* Hooker, *A. chamissonis* (Lessing) Greene, *A. confertiflora* de Candolle, *A. psilostachya* de Candolle (Goeden and Ricker 1974a, b, 1975), and *A. trifida* L. (Pierce 1916, Hack 1935, Tuttle 1952); *C. operculatus* (Say) from *A. trifida* (Pierce 1916, Hack 1935, Tuttle 1952); *C. operculatus* (Say) from *A. trifida* (Tuttle 1952); *C. littoralis* (Fall) from *A. chamissonis* (Goeden and Ricker 1974b); and *C. quercus*, an associate of *A. artemisiifolia* (Kissinger 1963).

Biological observations of *C. quercus* are based on rearings initiated by adults, larvae, and pupae collected in or near the city of Kent (Portage County) in northeastern Ohio. Laboratory rearings were maintained at room temperatures of 20°-25°C, 50%-60% RH, and a 12/12 hr photoperiod.

LIFE HISTORY

Cylindrocopturus quercus has been recorded from New York, south to Georgia, and west to Iowa (Leng 1920). The oval, robust adults range from 2.3-3.0 mm in length and are covered with cupreous, tan, and white scales dorsally and grayish-white scales ventrally.

Adult emergence began during early June and essentially was completed by late July. Peak populations were found 2-3 weeks after the 1st emergence. Males emerged first, followed in a few days by the females. Both sexes were collected in approximately equal numbers throughout June and July. Laboratory-reared males lived from 30-40 days; females from 32-50 days. There was only 1 generation/yr in northeastern Ohio.

Adult feeding was restricted to ragweed leaves. The weevils cut holes through the upper epidermis with their mandibles, inserted their rostrums into the punctures, and devoured the mesophyll between the upper and lower epidermal layers. Heavily damaged leaves (Fig. 1) were chlorotic, and leaf abscission usually occurred prematurely.

In nature, adults rarely were seen moving about on the foliage and were not easily collected. Most commonly the weevils were found clinging to the stems. In the laboratory, *C. quercus* adults were most active during the late morning and early evening hours. The weevils are thanatotropic and drop immediately when disturbed, their coloration blending with the soil and/or litter beneath the host plants.

The premating period (from emergence to 1st copulation) of 10 laboratory-reared females ranged from 4-6 ($X=5$) days. No definitive courtship behavior was observed. All matings observed in the field occurred on the lower surfaces of leaves and in leaf axils of common ragweed. The male mounted the female by approaching from either the front or rear. When the male approached and mounted from the front, he immediately reversed his position on the female and aligned his body with hers so that both faced in the same direction. The male grasped the female in the following manner: The front legs were positioned against the prothorax just caudad the compound eyes; the middle legs grasped the abdomen between the female's middle and front legs; and the hind legs were lightly appressed against the abdomen near the genitalia (Fig. 2). Most females generally were quite passive after the initiation of copulation and often fed while in copula. Occasionally a female would attempt to dislodge a male by swinging her abdomen back and forth transversely in pendulum fashion. When the female started to move to a new location on the plant, copulatory activity was suspended immediately; the male merely rode the female's dorsum until another feeding site was selected. Mating time (from mounting to cessation) varied from 5-60 min. Adults in copula were infrequently seen or collected in nature. In the laboratory, mating occurred repeatedly during the period preceding the 1st oviposition, but steadily declined in frequency as the female aged. Mating occurred at various times of the day in the rearing containers.

The preoviposition period (from emergence to 1st deposition of eggs) of 4 females varied from 8-15 days. These females each laid an average of 2 eggs/day over a 10-37 day period. Daily egg-laying varied from 0-7 eggs/female, and the total number of eggs laid/female ranged from 17-83. Oviposition was restricted to the late morning or early afternoon hours. A gravid female usually selected a site on the lower third or two-thirds of a stem, directly beneath a leaf petiole base, for oviposition.

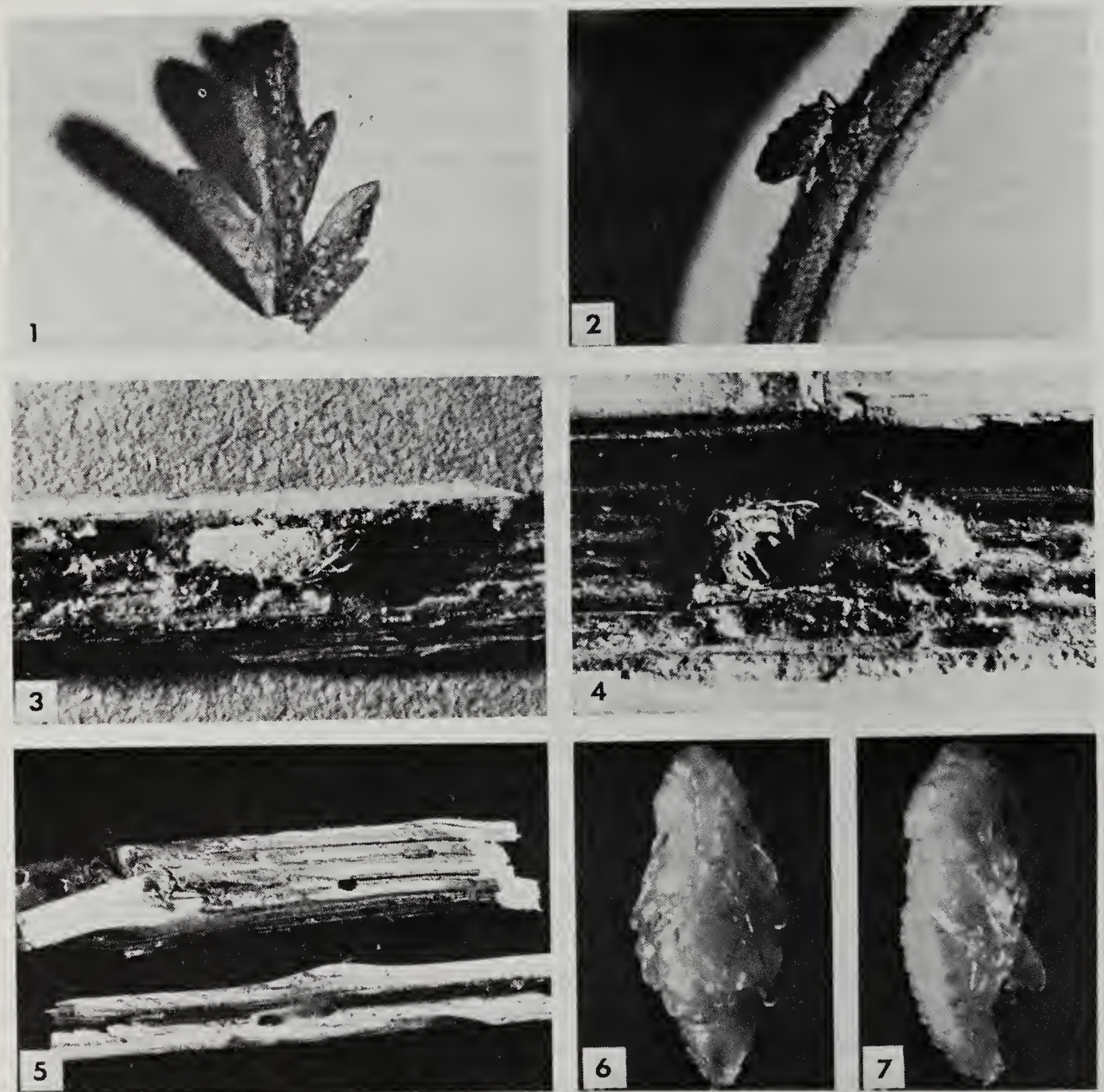
She oriented her body on the stem with the head directed downward and chewed a hole through the epidermal and cortical tissues. Upon completion of the excavation, the female executed a 180° turn to the right, located the hole with the tip of the abdomen, and deposited an egg near the cavity. The female reversed her position again, pushed the egg inward with her rostrum, and proceeded to conceal the egg by using her mandibles to tease out the stem tissues bordering the oviposition hole. Only 1 egg was deposited/hole. The total time required for egg chamber excavation and oviposition was 15-20 min. Commonly 8-10 eggs were found per stem. The incubation period of 25 eggs held at room temperatures ranged from 8-10 ($X=9$) days. The viability of these eggs exceeded 90%.

Larval emergence was preceded by vigorous peristaltic inflation and contraction of the body, flexing of the head, and mandibular movement. Larvae initially ruptured the chorion with their mandibles, enlarged the tear thru body movements, and eventually emerged from the egg. The head was the last portion of the larva to be extracted from the chorionic remnant.

Upon hatching, larvae fed upon the decaying tissues within the egg chambers. Second-stage larvae tunneled cortical and vascular tissue. Feeding activity of third-stage larvae resulted in destruction of portions of the vascular tissue (leaf trace severance) and pith. The linear feeding galleries varied from 1-3 ($X=2$) cm in length and were packed with fine powdery frass. Even though as many as 10 larvae were found per stem, the extensive tunneling did not appear to distress the weed. Larval feeding damage occurred too late in the growing season to have any significant effect upon the competitive or reproductive capacities of ragweed. The length of time spent in each larval stadium could not be determined accurately, but the first stadium generally was completed in 4-5 days, and the second stadium in 12-20 days under laboratory conditions. Mature larvae remained in the third stadium from early fall until the following May or June.

From late August until mid-October, mature larvae constructed pupal chambers at the ends of the feeding galleries. The elongate, oval chambers (Figs. 3, 4) were situated against the inner stem wall and were constructed from frass, composed primarily of strands and flakes of sclerenchyma and xylem tissue, cemented together with larval excrement. The chambers, measuring 6 mm in length and 2 mm in diameter, were constructed so that their greatest length was parallel to the stem's upright axis. Once the cells were formed, the larvae chewed small emergence holes, approximately 1 mm in diameter, completely through the stem walls. The larvae then plugged the apertures with fine powdery frass. The amount of time required to complete the pupal chamber was not determined. The mature larvae overwintered in a state of temperature-induced quiescence within these chambers.

A definite prepupal stage in *C. quercus* was observed. Three to four days prior to pupation, larval activity slackened and the insect became distended. Larvae transformed into pupae from late April to mid-May. Field investigation revealed that the larvae always pupated head upward within the chambers. Sequential body coloration changes were observed throughout the pupal period. The first structures to darken were the eyes, followed in rapid succession by the mandibles, tarsal claws, and femora apices. The pupal period of 25 individuals lasted 11-15 ($X=12$) days. Adults emerged via the exit holes previously cut in the stem walls (Fig. 5).



Figs. 1-7. *Cylindrocopturus quercus*. 1) Adult feeding damage. 2) Mating position of adults. 3) Intact pupal cell. 4) Pupal cell cut away to reveal mature larva. 5) Emergence holes in stem. 6) Pupa, ventral view. 7) Pupa, lateral view.

DESCRIPTIONS OF IMMATURE STAGES

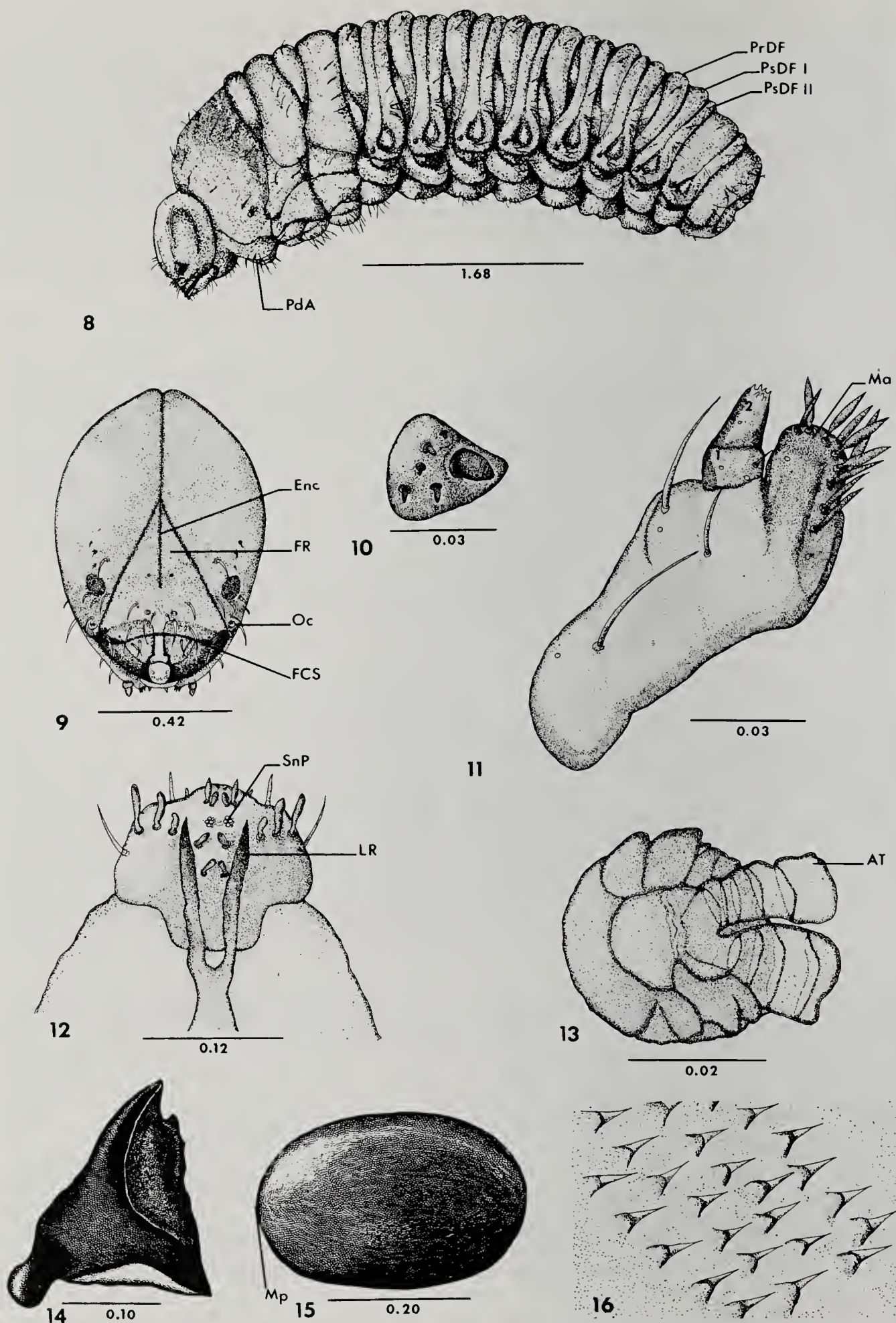
Egg. (Fig. 15). Length 0.35-0.43 mm, maximum width 0.25-0.27 mm (25 specimens). Yellowish-tan. Broadly oval, ends bluntly rounded; one end slightly larger than the other. Chorion smooth, without pattern. Micropyle located terminally.

First Instar. Terminology of larval characters follows Anderson (1947). Similar to third instar except in following characters. Length 0.33-0.45 mm, head capsule width 0.18-0.19 mm (25 specimens). Color translucent yellow. Prodorsal and postdorsal folds of meso- and metathorax and abdominal segments 1-7 not prominent; setae, except for those on head, minute.

Second Instar. Similar to third instar except in following characters. Length 0.72-0.92 mm, head capsule width 0.23-0.24 mm (25 specimens).

Third Instar (Fig. 8). Length 3.08-4.42 mm, head capsule width 0.50-0.72 mm (25 specimens). Color white or cream; integument thin, covered with many minute pointed asperities. Body subcylindrical, cyphosomatic, slightly tapered posterad. Head capsule yellowish-brown; elongate oval; posterior half of capsule retracted into prothorax. Endocarina distinct. Frontal suture V-shaped (Fig. 9), extending to antennal bases. Frons complete with 10 setae and 4 sensilla; frontal setae 1 and 2 shorter than either 3, 4 or 5; setae 3, 4 and 5 approximately equal in length. Antennae (Fig. 10) located at distal ends of frontal suture; basal article with 5 sensory papillae. Anterior ocelli present; lenses convex; pigment bodies present. Epicranial halves each with an oval, dark brown area posterad to each ocellus. Five pairs of dorsal epicranial setae present; setae 2 and 4 shorter than setae 1, 3, and 5. Lateral epicranial seta 2 longer than 1. Ventral epicranial setae 1 and 2 equal in length. Four pairs of minute posterior epicranial setae. Distinct fronto-clypeal suture present; clypeus twice as long as wide with 4 long setae and 2 sensilla. Labrum twice as long as wide with 3 pairs of setae, labral seta 1 longer than 2 or 3; 2 lateral sensilla present. Epipharynx (Fig. 12) with 3 flattened anterolateral setae on each side, 6 anteromedian setae, and 2 pairs of median spines; labral rods sclerotized; elongate; sub-parallel, convergent posteriorly. Epipharyngeal sensory pores in 2 clusters, 4 in each cluster, located anterior to the median spines. Mandibles (Fig. 14) stout, blackened and bidentate apically; mandibular setae 1 and 2 subequal in length. Apical article of maxillary palpus longer than basal article (Fig. 11); ventral inner surface of basal article with 2 sensilla placodea; apical article with 1 sensillum placodeum, tip of apical article invested with 7-8 sensilla basiconica; inner margin of maxillary mala with 5 ventral setae and 7 dorsal spatulate setae. Prementum of labium with 2 short setae; premental sclerite reddish-brown; trident shaped. Glossa with 4 small setae. Basal article of labial palpus longer than apical article; tip of apical article with 5-6 sensilla basiconica. Postmentum with 3 pairs of setae. Pronotum non-lobate; lightly sclerotized; complete with 20 setae, 10 on each side of meson; posterior half asperate (Fig. 16). Prothoracic epipleural lobe without setae; pleural lobe with 2 setae; sternum with 2 setae. Prodorsum of meso- and metathorax each bearing 1 short seta on each side of meson; postdorsum of meso- and metathorax each bearing a row of 4 setae on each side of meson. Meso- and metathoracic epipleural lobes each with 2 setae; meso- and metathoracic pleural lobes each with 1 seta. Meso- and metasternum each with 2 setae. Legless. Pedal areas of thoracic segments protuberant; each with 6 setae. Abdominal segments 1-7 each with 3 dorsal folds. Postdorsal folds of segments 1-7 more prominent than prodorsal folds. Prodorsum of each segment with 1 seta on each side of meson; postdorsum of each segment with a row of 4 setae on each side of meson. Epipleural lobes prominent on segments 1-8, each with 2 setae; pleural lobes each with 1 seta; pedal areas small, bearing 1 seta. Eusternum of segments 1-8 with 4 setae; sternellum glabrous. Segment 8 with 2 dorsal folds. Segment 9 subconical with 6 setae. Anus terminal; surrounded by 4 lobes; dorsal and lateral lobes each with 2 setae. Spiracles bicameral, small, air tubes with 4-5 annuli; peritremes feebly sclerotized (Fig. 13). Paired spiracles located on mesothorax and abdominal segments 1-8; mesothoracic spiracle largest; all spiracles ringed with black.

Pupa (Fig. 6, 7). The terminology of pupal characters follows Burke (1968). Length 3.38-3.96 mm (25 specimens). Body closely resembling form of adult in size, shape, and proportions of cephalic and thoracic appendages; exarate; color creamy white. All spines and setae arise from tuberculate bases; dark brown. Rostrum and antennae extending to anterior margin of mesothoracic sternum; 2 pairs of short distirostral setae near middle of rostrum; 1 pair of long basirostral setae near rostrum base. Head small, rounded; 1 pair of long supraorbital setae; 1 pair of short frontal



Figs. 8-16. *Cylindrocopturus quercus*, third instar larva and egg. 8) Lateral habitus, head exserted. 9) Head capsule, frontal view. 10) Antenna. 11) Right maxilla, ventral view. 12) Epipharynx, ventral view. 13) Abdominal spiracle. 14) Right mandible, ental view. 15) Egg. 16) Pronotal spines. All measurements indicated by scale lines are in millimeters. AT, air tube; Enc, endocarina; LR, labral rod; FCS, frontoclypeal suture; FR, frons; Ma, Mala; Mp, micropyle; Oc, ocellus; PdA, pedal area; PrDF, prodorsal fold; PsDF, postdorsal fold; SnP, sensory pore.

setae. Prothoracic depressions lacking. A pair of anteromedian setae near anterior margin of pronotum; 2 pairs of widely separated anterolateral setae; 1 pair of widely separated posteromedian setae near middle of pronotum; 4 pairs of posterolateral setae. Mesonotum smooth with a pair of closely spaced mesonotal setae on each side of midline; scutellum protuberant, glabrous. Mesothorax with a large, oval, functional spiracle. Metanotum smooth, shining; pair of metanotal setae on each side of scutellar groove. Elytra and wings extending to anterior margin of abdominal sternum 4. Abdominal terga 1-7 protuberant; 2 pairs of discotergal setae and 1 pair of laterotergal setae on each tergum. Tergum 8 short, tapered; 1 pair of discotergal setae. Abdominal segment 9 short, concealed below 8; armed with a pair of long, widely separated, strongly chitinized posterior processes. Sterna shining, glabrous; sternum 3 the largest. Legs each with 2 setae near apex of femur, hind femora extending to abdominal segment 5; tibiae and tarsi directed posterad. Functional spiracles on segments 1-7; annular; non-sclerotized.

ACKNOWLEDGMENTS

Appreciation is extended to H. R. Burke and G. W. Frankie, Texas A&M University, College Station, for reviewing the manuscript; E. L. Sleeper, California State College at Long Beach, for determining the weevil; and C. W. O'Brien, Florida A&M University, Tallahassee, for providing taxonomic information on the genus *Cylindrocopturus*.

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BOOK REVIEW

Entomology in the U.S.A., edited by A. P. Gupta. 1976. The XV International Congress of Entomology, Washington, D.C. (distributed by the Entomological Society of America, 4603 Calvert Rd., College Park, Md. 20740). Paper, 159p., \$3.00.

This brochure is the result of an attempt to provide a single source of information on "... entomologists and entomological centers in this country." It was compiled by members of the National Brochure Committee of the Entomological Society of America. Very brief summaries of the origin and history of this society as well as its five branches are presented in the first seven pages. The bulk of the remaining pages contain a listing, of states (including D.C.), of entomological centers and staff. The centers for each state are grouped under ten categories: Universities; Colleges; Industrial and Private Organizations; State Government Organizations; USDA—Agricultural Research Service; USDA—Animal and Plant Health Inspection Service; USDA—Forest Service; HEW—Public Health Service—Center for Disease Control; EPA; and Miscellaneous. For each center the authors provide (1) a brief summary of its history and activities, (2) a short statement (often one word) as to its function, and (3) a list of staff members giving their titles, their highest degrees and fields of interest (ecology, medical entomology, physiology, etc.). Unfortunately, taxonomic interest listings are limited to staff members of museums (under Miscellaneous). Had taxonomic interests been given for *most* entomologists listed in the brochure, this volume undoubtedly would be a superb contribution to entomology. In all fairness, however, it must be stated that it is a very good compilation of information on entomology in the U.S.A.

—Paul P. Shubeck